BAB 5
KESIMPULAN DAN SARAN

5.1 Kesimpulan

Dari hasil dan pembahasan penelitian yang telah dilakukan dapat diambil kesimpulan bahwa penambahan ion logam K^+ pada konsentrasi 1 mM dan 5 mM dapat meningkatkan aktivitas ekstrak kasar enzim selulase dari isolat *Bacillus subtilis* Strain SF01sebesar 5 %, penambahan ion logam Co^{2+} pada rentang konsentrasi 0,1 mM – 10 mM dapat meningkatkan aktivitas ekstrak kasar enzim selulase dari isolat *Bacillus subtilis* Strain SF01sebesar 17 % dan penambahan ion logam Ba^{2+} pada rentang konsentrasi 0,1 mM – 10 mM dapat meningkatkan aktivitas ekstrak kasar enzim selulase dari isolat *Bacillus subtilis* Strain SF01sebesar 30 %, sedangkan penambahan ion logam Fe^{3+} tidak memberikan pengaruh terhadap aktivitas ekstrak kasar enzim selulase dari isolat *Bacillus subtilis* Strain SF01 pada rentang konsentrasi 0,1 mM – 10 mM.

5.2 Saran

Dari hasil pembahasan penelitian yang telah dilakukan disarankan dapat menggunakan penambahan ion logam Ba^{2+} dalam proses produksi, purifikasi dan karakterisasi enzim pada penelitian selanjutnya karena pada penambahan ion logam Ba^{2+} dapat meningkatkan aktivitas enzim selulase dari isolate *Bacillus subtilis* Strain SF01 paling besar yaitu 30%.

DAFTAR PUSTAKA

Ambriyanto, K. S. 2010, *Isolasi dan Karakterisasi Bakteri Aerob Pendegradasi Selulosa dari Serasah Daun Rumput Gajah (Pennisetum purpureum schaum*, Fakultas Matematika dan Ilmu Pengetahuan Alam, Institut Teknologi Sepuluh November, Surabaya.

Anindyawati, T. 2010, *Potensi Selulase dalam Mendegradasi Lignoselulosa Limbah Pertanian Untuk Pupuk Organik*. *Berita Selulosa*. Vol. 45(2):70-77.

Arifin, Z. 2008, Beberapa Unsur Mineral Esensial Mikro Dalam Sistem Biologi Dan Metode Analisisnya, Balai Besar Penelitian Veteriner, Bogor, Dalam *Jurnal Litbang Pertanian*, 37(1): 22-27

Ariputri, D. R. 2014, *Identifikasi Isolat Bakteri Penghasil Enzim Selulase dari Limbah Ampas Tebu Berdasarkan Analisis Homologi Gen Penyandi 16S rRNA*, Fakultas Farmasi, UKWMS, Surabaya, Halaman 1-3.

Ayuningtyas, O. 2008, *Eksplorasi Enzim Selulase Dari Isolat Bakteri Selulolitik Asal Rumen Sapi*, Departemen Kimia, Fakultas Sains dan Teknologi, Airlangga, Surabaya, Halaman 21, 29, 27-28.

Baharuddin, Razak, Hock, Ahmad, Aziz, Rahman, Shah, Hassan, Sakai dan Shirai. 2010, Isolasi and Characterization of Thermophilic Cellulase-Producing Bacteria from Empty Bunches-Palm Oil Mill Effluent Compost. *Journal ofApplied Science*. Vol.7(1): 56-62.

Bradford, M.M. 1976, A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding, *Analytical Biochemistry*, 72, 248-254.

Broderick, J. B., 2001, *Coenzymes and cofactor' in Encyclopedia of life science*. Michigan State University, East Lansing, Michigan, USA.

Cantor, S. L., Ausburger, L., and Hoag, S. W. 2008, *Pharmaceutical Granulation Processes, Mechanism, and the Use of Binders in Pharmaceuticals Dossage Form : Tablets*, Ausburger, L. L., & Hoag, S. W., Informa Healthcare USA, Inc., New York, pp. 287-291.

Choundhury, H., And Cary, R., 2001, *Barium And Barium Compounds*, *World Health Organization, Geneva*.

Colwell, D. and Kresten, P. J. 1972, Enzymology and Molecular Biology of Lignin Degradation, in :*The Mycota III*, Biochemistry and Molecular Biology, Berlin-Heidelberg, 249-273.

Enari, T. M. 1983, *Microbial Enzimatic and Biotechnology*. W. M. Fogarty (eds). Applied Science Published London.

Fadillah, R.F. 2012, *Isolasi dan Identifikasi Bakteri Selulolitik Pengurai Sampah Organik dari Berbagai Tempat.* Skripsi. Bandung: Universitas Pendidikan Indonesia.

Fan, L.T., Lee, Y.H. and Gharpuray, M.M. 1982, The Nature of Lignocellulolosics and Their Pretreatments for Enzymatic hydrolysis. Adv. Biochem. Eng. 23.

Gilbert, H. F. 2000, *Basic Concepts in Biochemistry, A Student's Survival Guide 2nd Edition,* McGraw-Hill, USA.

Greenwood, N. N. and Earnshaw, A. 1984, Chemistry of the Element, *Pergamon Press*, Tokyo.

Gupta, P., Samant, K., and Sahu, A. 2011, Isolation of cellulose-degrading bacteria and determination of their cellulolytic potensial, *International Journal of Microbiology*, Vol. 45, No. 9. P.2761.

Gusakov, A., Samat, K. and Sahu, A., 2012, Isolation of Cellulose-Degrading Bacteria and Assaying Reducing Sugar in The Determination of Carbohydrase Activities. *International Journal of Analytical Chemistry*, 2011.

Hartanti, L., Susanto, F., Utami, C. P., Sukarti, E., Setiawan, H. K. dan Ervina, M., 2014, Screening and Isolation of Cellulolytic Bacteria from Bagasse and Characterization of The Cellulase Produce, Universitas Jember, *In Proceeding of International Protein Society Seminar,* Universitas Jember.

Hatami, S., H. A. Alikhami, H. Besharati, N. Salehrastin, M. Afrousheh. and Yazdani, J. .Z. 2008, Investigation of Aerobic Cellulolytic Bacteria in some of North Forest and Farming Soils. *American-Eurasian Journal of Agriculture and Environmental Sciences,* 3(5): 713- 716.

Holtzapple, M, T. 1993, Cellulose, *In : Encyclopedia in Food Science, Food Technology and Nutrition*, Academic Press, London, p. 2731-2733.

Howard, Abotsi, Rensburg. dan Howard. 2003, Lignocellulose Biotechnology: Issues of Bioconversion and Enzyme Production. *Review Journal of Biotechnology*. Vol. 2(12): 602-619.

Lehninger, A. L. 1993, *Dasar-dasar Biokimia, Jilid 1*, terjemahan M. Thenawidjaja, Penerbit Erlangga, Surabaya.

Lin, L., Kan, X., Yan, H. and Wang, D. 2012, *Characterization of extracellular cellulose-degrading enzymes from Bacillus thuringiensis strains*, College of Life Sciences, Anhui Normal University, Wuhu.

Li, W. Z. Z., Wei, H., Chaoliang, L., Xiao. dan, X. 2006, *Studies on Catalyzed Properties of Cellulase for Feeding*, **College of Life Science, Anhui Agricultural University, Hefei, Anhui, China.**

Marganingtyas, D. D. 2011, *Potensi Bakteri Selulolitik Indigenous Mangrove Terhadap Komposisi Limbah Tambak Udang*, Fakultas Perikanan, Universitas Brawijaya, Malang.

Meryandini, A., W. Widosari, B. Maranatha, T. C. Sunarti, N. Rachmania. dan H. Satria. 2009, *Isolasi Bakteri Selulolitik dan Karakterisasi Enzimnya*, Makara**,** 13, 34.

Merck and Co. 2001, *The Merck Index, 13th Edition*, Merck and Co. Inc, New Jersey.

Miller, G. L. 1959, *Use of Dinitrosalicylic Acid Reagent for Determination of Reducing Sugar, Analytical Chemistry*, 3(III): 426-428.

Moat, A.G., Foster, J.W., dan Spector, M.P. 2002, *Microbial Physiology Fourth edition.* New York: Wiley-liss, Inc.

Murray, R. K., Granner, D. K., Mayes, P. A., Rodwell, V. W. 2003, *Biokima Harper*, Diterjemahkan dari Bahasa Inggris oleh Anna P. Bani dan Tiara M. N. Sikumbang, EGC, Jakarta.

Nelson, D, L., & Cox, M, M. 2008, *Principles of Biochemistry*, Fifth Edition, New York: WH Freeman.

Padilha, I. Q. M., Carvalho, L. C. T., Dias, P. V. S., Grisi, T. C. S. L., Honorato da Silva, F. L., Santos, S. F. M. and Araújo, D. A. M. 2015, *Production And Characterization of Thermophilic Carboxymethyl Cellulase Synthesized by Bacillus sp. Growing on Sugarcane Bagasse in Submerged Fermentation*, Departamento de Biotecnologia, Centro de Biotecnologia, Universidade Federal da Paraíba, Campus I, Cidade Universitária, Brazil.

Poedjiadi, Anna. 1994, *Dasar-dasar Biokimia*, UI-Press, Jakarta, Halaman 145-146.

Pokhrel, B., Bashyal B., Magar, T. R. 2014, *Production, Purification and Characterization of Cellulase from Bacillus subtilis Isolated from Soil*, Department of biochemistry, Universal Science College Chakupat, Lalitpur.

Prescott, S. C., Dunn, M. 1981, *Industrial Microbiology*. New York: Mc. Graw Hill Book. Co. Ltd.

Sadikin, M. 2002, *Biokimia Enzim*. Penerbit Widya Medika. Jakarta.

Safriani. 1995, Kajian Kondisi Fermentasi pada Selulase dari Limbah Kelapa Sawit (Tandan Kosong dan Sabut) oleh *Neurospora sitophila. Skripsi.* Bogor. Fakultas Teknologi Pertanian IPB. Sari, R.F. 2010.

Scopes, R.K. 2002, Enzyme Activity and Assays in *Encyclopedia of Life Science*. La Trobe University, Bundoora, Victoria, Australia

Shahib, M, N. 1992, *Pemahaman Seluk Beluk Biokimia Dan Penerapan Enzim*, Bandung: PT.Citra Aditya Bakti.

Shanmugapriya, K., Saravana, P.S., Krishnapriya, Manoharan, M., Mythili, A. and Joseph, S. 2012, Isolation, Screening and Partial Purification of

Cellulase from Producing Bacteria. *International Journal of Advanced Biotechnology and Research,* 3(1).

Soleimanzadeh, H., Habibi, D., Ardakani, M.R., Paknejad, F. and Rejali, F. 2010, Effect of Potassium Levels on Antioxidant Enzymes and Malondialdehyde Content under Drought Stress in Sunflower (Helianthus annuus L.), *Am. J. Agric. Biol. Sci*., 5: 56-61. DOI: 10.3844/ajabssp. 2010. 56. 61.

Sukumaran, R.K., Singhania, R.R dan Pandey, A. 2005, Microbial Cellulases: Production, Applications and Challenges. *Journal of Scientific & Industrial Research.* 64: 832-844

Susanto, F. 2012, *Skrining Dan Isolasi Bakteri Penghasil Enzim Selulase Dari Limbah Tebu,* Fakultas Farmasi, UKWMS, Surabaya, Halaman 2-3, 61.

Williamson, K.L. and Fieser, L. F. 1992, *Organic Experiment* 7th Edition, United States of America: D C Health and Company.

Winarno, F.G., Fardiaz, S. 1990, *Biofermentasi dan Biosintesa Protein,* Edisi X, Angkasa, Bandung.

Wuryanti. 2004, Isolasi Dan Penentuan Aktivias Spesifik *Enzim* Bromelin Dari Buah Nanas. No. Artikel: *JKSA.* Vol. VII. No.3.

Yin, L. J., Lin, H. H. and Xiao, Z. R. 2010, Purification and Characterization of A Cellulase from Bacillus subtilis YJ1, *in Journal of Marine Science and Technology.* Vol. 18, No.3

Zhang, X. and Zhang, Y. P. 2013, *Cellulase: Characteristics, Sources, Production, and Applications* in Tian-Yang, S., Hesham, A., El-Enshasy and Thongchul, N., *Bioprocessing Technologies in Biorefinery for Sustainable Production of Fuel, Chemicals and Polymers*, 1st Edition, John Wiley and Sons, Inc., pp 131-146.